VENTILATED PLASTIC BLOCKS WITH FILM LAMINATE

CROSS REFERENCE TO RELATED APPLICATIONS

The present application is a continuation-in-part application of an application entitled "Solar Reflective Ventilated Translucent Blocks" filed October 14, 2003, and assigned Serial No. 10/684,921, which is a continuation-in-part application of an application entitled "Ventilated Interlocking Translucent Blocks", filed May 8, 2002, and assigned Serial No. 10/142,306.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to transparent/translucent blocks as building materials used in commercial and residential construction and, more particularly, to a ventilated interlocking block of manmade material and having a solar reflective/absorbtive film laminate peripherally supported there within.

2. Description of Related Art

For decades, hollow glass blocks have been used to form interior or exterior walls or sections thereof in order to permit transmission of light through such walls. Usually, these glass blocks distort any images viewed therethrough or the blocks may be translucent to permit passage of light and yet provide a significant degree of privacy. For example, glass blocks have been used as part of a bathroom wall to permit transmission of light therethrough, particularly

important if there are no windows in the bathroom, and yet provide privacy. In a commercial or private environment, walls or wall dividers have been formed of translucent hollow glass blocks to delineate floor space while accommodating light transmission therethrough to create a more airy and open environment without compromising privacy.

Hollow glass blocks serve the sought end result very well but several difficulties are created. First, the glass blocks are relatively heavy and building codes generally only permitted them to be used in conjunction with supporting brick walls; conventional wood frame construction is generally considered of insufficient structural strength to support a panel of glass blocks. Second, transport of the glass blocks from a point of manufacturer to the end user is generally expensive because of the weight and the attendant crating and shipping costs. Third, in order to accommodate the change in pressure within the hollow part of the glass block due to temperature and elevational changes, the glass walls must be very thick. Fourth, assembling a wall, wall section or panel of glass blocks requires a skilled artesian to properly align the glass blocks and to exercise skill in securing the glass blocks to one another with a binding agent. Fifth, exterior walls of glass block permit solar transmission therethrough causing heating of the environment interior of the glass block panel.

To overcome the weight and handling difficulties attendant hollow glass blocks, hollow blocks of transparent/translucent manmade materials, such as acrylic plastic, have been developed, hereinafter referred to as plastic blocks. These plastic blocks generally include interlocking elements to permit seating and rapid assembly. In some circumstances, depending

upon the configuration and use of the plastic blocks, a binding and/or sealing agent must be used. The primary benefits of plastic blocks include light weight, ease of handling and installation, and relatively low cost.

The plastic blocks are hollow and the interior space is sealed against intrusion of foreign matter as well as air. In response to temperature changes or changes in elevation (primarily during shipping), the pressure within the plastic blocks increases and decreases proportionately. The pressure changes within the plastic blocks generally result in inward or outward flexing of the walls of the plastic blocks. Such flexing creates stresses within the plastic material. During cleaning with conventional cleaning agents, lines of stress become visually apparent. The resulting disfiguration becomes permanent and compromises the aesthetics of the wall, wall section or panel formed of the plastic blocks.

As with glass blocks, transparent or translucent plastic blocks permit penetration of solar radiation. The solar radiation transmitted into the plastic block impinges upon the interior side wall and causes heating of the interior side wall. Heat from the interior side wall will radiate into the adjacent environment and raise its temperature. Furthermore, solar radiation transmitted through the plastic block will heat any solar radiation impinged objects and the temperature of the ambient environment will be raised. If the solar radiation is particularly intense, it can also cause damage to or deterioration of objects by heating them and/or if they are photo sensitive to the frequency spectrum of the solar radiation.

SUMMARY OF THE INVENTION

The present invention is directed to ventilated transparent and/or translucent hollow plastic blocks having interlocking elements for rapidly building a wall, a wall section or a panel of such plastic blocks. Ventilation of the plastic blocks to avoid imposing stresses on the walls of the plastic blocks due to temperature changes and elevational changes is provided. A sheet of material for reducing transmission of solar radiation through the plastic block extends across the interior of the plastic block to restrain transmission of solar radiation through the plastic block and to divide the plastic block into two compartments. Equalization of pressure within each plastic block with the ambient pressure is provided by a single vent disposed in the bottom side wall of a mounted plastic block. The vent is also in fluid communication with the interior space of each of the two compartments. By having two compartments within each plastic block, the transmission of heat from one compartment to the other is restrained and the temperature difference between the exterior surfaces of the opposed sides of the plastic block is enhanced.

It is therefore a primary object of the present invention to provide a ventilated plastic block that reduces transmission of solar radiation therethrough.

Another object of the present invention is to provide a ventilated translucent or transparent plastic block for use as a wall section or panel and having a film of solar radiation attenuating material therein to reduce heating of the plastic block adjacent the interior surface of the wall section or panel.

Yet another object of the present invention is to provide a spectrally selective interior of a ventilated plastic block and divide the interior space into two compartments.

Still another object of the present invention is to provide a single vent for ventilating the space on either side of spectrally selective film laminate extending across the interior of a plastic block used in the construction of a wall or of a panel.

A further object of the present invention is to provide a specifically located single aperture serving as a vent in a transparent or translucent hollow plastic block to reduce the likelihood of condensation settling on the interior surfaces of the hollow plastic block or on a spectrally selective film laminate extending across the interior of the hollow plastic block.

A yet further object of the present invention is to provide a two part ventilated transparent or translucent plastic block having a spectrally selective film laminate mounted therebetween.

A still further object of the present invention is to provide a method for assembling a spectrally selective film laminate within a hollow transparent or translucent plastic block.

A still further object of the present invention is to provide a method for avoiding stressing the side walls of a hollow plastic block having a sun screen disposed therein due to pressure changes resulting from ambient temperature and pressure changes.

A still further object of the present invention is to provide a method for reducing transmission of solar radiation through a hollow transparent or translucent plastic block.

These and other objects of the present invention will become apparent to those skilled in the art as the description there proceeds.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be described with greater specificity and clarity with reference to the following drawings, in which:

Figure 1 illustrates a plurality of interlocked plastic blocks;

Figure 2 is a cross sectional view taken along lines 2-2, as shown in Figure 1;

Figure 3A is a cross sectional view taken along lines 3A-3A, as shown in Figure 2;

Figure 3B illustrates a variant of the ventilation aperture shown in Figure 3A;

Figure 4 is a cross sectional view taken along lines 4-4, as shown in Figure 3A;

Figure 5A illustrates the two halves or members of a plastic block prior to assembly;

Figure 5B is a detailed view of the section encircled and identified with reference numeral 5B shown in Figure 5A;

Figure 6 illustrates the two halves or members of a plastic block prior to assembly and having an interleaved spectrally selective film laminate;

Figure 7 is a partial view illustrating the vent in the plastic block in fluid communication with the space or compartment on either side of the sun screen;

Figure 8 illustrates the reflection of solar radiation of a transparent or translucent plastic block having an interiorly located spectrally selective film laminate;

Figure 9 illustrates a partial cross section of two interlocked plastic blocks, each plastic block supporting spectrally selective film laminate retained without an adhesive at the junction of the members of the plastic blocks;

Figure 9A is a detail view taken within dashed circle 9A and illustrates the use of an adhesive to retain the spectrally selective film laminate;

Figure 10 illustrates a plastic block set within a vinyl frame;

Figure 11 illustrates a plastic block set within an aluminum frame;

Figure 12 illustrates a plurality of transparent or translucent plastic blocks mounted within a circumscribing frame;

Figure 13 illustrates the construction of a film laminate having a spectrally selective coating to be mounted within a plastic block;

Figure 14 is a chart illustrating test results of a film laminate having a spectrally selective coating; and

Figure 15 is a chart illustrating Energy Star qualification criteria.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Interlocking unventilated plastic locks have been developed by the applicant, as illustrated and described in U. S. Patent No. 5,836,125. The illustrations and writings contained therein are incorporated herein by reference. Accordingly, many of the features common with the present invention, particularly with respect to the interlocking and alignment elements, will be only summarily discussed as the details thereof are set forth in U.S. Patent No. 5,836,125.

Referring to Fig. 1 there is shown a plurality of interlocking plastic blocks 10, 10A and 10B which are preferably, but not necessarily, of acrylic material. Edge 12 of each plastic block includes two pairs of alignment tabs 14A, 14B and 16A, 16B. The tabs of each pair of these tabs are relatively widely spaced from one another, as illustrated. Opposite edge 18 of plastic block 10 includes two pairs of alignment tabs of which tabs 15A,15B are shown; these pairs of tabs are spaced closer to one another than pairs of tabs 14A,14B and 16A,16B. Edge 20 of each plastic block also includes two pairs of alignment tabs 22A,22B and 24A,24B. The space between the alignment tabs of these two pairs of tabs is less than the space between pairs of alignment tabs 14A,14B and 16A,16B and corresponds with the spacing of pairs of tabs 15A,15B. Edge 26 of each plastic block includes two pairs of alignment tabs equivalent in spacing and location to pairs of alignment tabs 14A,14B and 16A,16B. Each of these alignment tabs bears against the inside surface of a corresponding one of circumferential flanges 30, 32 of an adjacent interlocking plastic block. Moreover, flanges 30, 32 serve as the bearing surfaces between adjacent blocks. Thereby, plastic blocks 10, 10A and 10B are easily assembled with one another in perfect alignment to form a wall section, window, divider, etc.

Generally, an assembly of plastic blocks is bounded by structure such as a strap or the like to ensure stability of the assembled structure wherein the structure is to be used. Additionally, a frame of wood, metal or other material may be used as a boundary within which the plastic blocks are mounted. A mastic or other binding agent may be used to secure the blocks to one another.

As particularly shown in Figure 2, a snap fit mechanism may be incorporated to retain the blocks in place with one another during assembly. As the details of the snap fit mechanism are fully described in U. S. Patent No. 5,836,125 the following discussion will be relatively brief. Snap fit mechanism 40 may include a female receptacle 42 to be engaged by a male coupling 44. The female receptacle includes a pair of cylindrical locking members 46,48 located at the extremity of respective wall members 50,52. Male coupling 44 includes a cylindrical member 54 supported upon a wall member 56. As shown in Figure 2, the spacing between cylindrical members 46,48 of female receptacle 44 is less than the diameter of cylindrical member 54 of male coupling 44. To permit penetration therebetween, wall members 50,52 of the female receptacle are resilient and sufficiently flexible to permit insertion and removal of the male coupling. As shown in Figure 1, and other figures, each side of each plastic block may include a pair of snap fit mechanisms 40. As further noted in Figure 1, edge 12 supports a male coupling 44 and opposite edge 18 supports a female receptacle 42. Edge 20 supports a female receptacle 42 and opposite edge 26 supports a male coupling 44. Thereby, the plastic blocks will be oriented to locate bottom edge 18 of one plastic block adjacent the top edge of another plastic block. When such placement occurs, the alignment tabs will be properly mated and the

corresponding snap fit mechanisms will be functional.

As particularly shown in Figures 4 and 5A, each of the plastic blocks (10, 10A, 10B) is formed of two members 60,62. Member 60 includes a four-sided side wall 64 and member 62 includes a similar four-sided side wall 66. For structural reasons and to obtain a good bond between the members, side wall 64 includes a peripheral lip 68 that mates with a peripheral undercut 70 in side wall 66. Upon mating and bonding members 60,62 with one another, an enclosed space is formed within the two members.

During transport of the plastic blocks, changes of elevation occur. Such changes of elevation would create a pressure differential between the space interior of each plastic block and ambient pressure. Unless each plastic block were vented, such pressure differential would cause the sides of the plastic block to flex in response to the degree of pressure differential. Similarly, during changes of the ambient temperature as a result of a plastic block being subjected to solar radiation, other source of heating or a cooling environment, the temperature within a sealed plastic block would change with a commensurate increase or decrease in pressure of the contained air and the sides of the plastic block would flex in conformance therewith.

One of the reasons for having prior art glass blocks and prior art plastic blocks sealed is to prevent condensation to develop on the inside surfaces due to a change in temperature or ambient pressure by preventing air flow through such a block. However, it has been learned that the plastic blocks of the type illustrated and described herein can be vented without a resulting

condensation and thereby obviate a pressure differential between the interior of the plastic block and the ambient pressure and prevent flexing of the sides of the plastic block. However, it has been learned that such venting must be configured in a specific manner to prevent cross flow within the plastic block and to minimize an air exchange with attendant introduction of moisture laden air. Furthermore, it has been learned that if the vent is on the bottom edge, any condensation that may develop, although unlikely, it can and will drain through the vent.

Referring particularly to Figures 4, 5A and 5B, the vent developed for use with plastic block 10 will be described. Vent 80, located in bottom edge 18 of plastic block 10 is formed by a slot 82 extending into side wall 66 past undercut 70. Upon mating of side walls 64,66 lip 68 covers a part of slot 82 to the extent of the width of undercut 70. The resulting vent is particularly shown in Figures 2 and 3A.

Vent 80 accommodates a flow of air into and out of plastic block 10 only as a function of changes in pressure outside or inside the plastic block. The vent is sized small enough to preclude any cross flow of air within the plastic block. That is, air can not enter at one location and depart at a different location. With such lack of cross flow within the plastic block, it has been learned that condensation within the plastic block will almost never occur. Yet, the use of a single vent of relatively small size will preclude flexing of the sides of the plastic block causing the stresses that ultimately will become visible upon cleaning the plastic block with conventional cleaning agents.

Figure 3B illustrates a variant vent 90 of vent 80. A simple hole in one side wall of block 10 may be formed therein during fabrication of the respective member 60/62 provided that such apertured side wall be at the bottom when the plastic block is mounted in place. Under certain circumstances, variant vent 90 may be formed post manufacturing by drilling a hole, as illustrated.

By experimentation, it has been learned that the size of vent 80 or variant vent 90 should have an area equivalent to a round hole having a diameter in the range of about 0.005 inches to about 0.25 inches. Optimally, the size of vent 80 or variant vent 90 should have an area equivalent to a circle having a diameter in the range of about 0.012 inches to about 0.015 inches to minimize the likelihood of inflow of moisture and yet permit an outflow of moisture if such inflow does occur. Thereby, an environment of trapped moisture will be eliminated. These area dimensions were developed as a result of significant testing during transport of the plastic blocks over roads having varying elevations and by subjecting them to temperature differentials over a period of time.

Referring to Figure 6, a pair of members 60, 62 as described in detail above, are illustrated; as may be noted, these members are reversed with respect to the same members shown in Figure 5A. That is, undercut 70 is in upper member 62 and lip 68 is in lower member 60. The two sides of these members not shown in this Figure support male couplings 44, as shown in Figure 5A. A film laminate 100 incorporating a spectrally selective coating is interleaved between members 60, 62. This spectrally selective film laminate serves in the

manner of a sun screen to reflect, absorb and transmit differing quantities of solar radiation as a function of the material itself and the parameters thereof. An acceptable type of film laminate for this purpose is identified as product number N1020 SR CDF sold by CP Films, Inc. of Martinsville, Virginia,

Preferably, film laminate 100 is dimensioned to rest upon shelf 102 interior of lip 68. Upon mating of members 60 and 62, flange 104 attendant undercut 70 will nest within lip 68 and bear against film laminate 100 supported by shelf 102. Thereby, film laminate 100 is mechanically retained intermediate member 60, 62 at the intersection thereof. Members 60 and 62 may be fastened to one another and to the film laminate with an acrylic glue.

Upon mounting of film laminate 100 within plastic block 10, the film laminate will define one compartment 105 within member 60 and a further compartment 108 within member 62 (see Figure 11). As discussed above, changes in temperature within or without plastic block 10 will result in a change of pressure within the plastic block. Any such change of pressure within the compartment formed in either of members 60, 62 may result in bowing of film laminate 100. To prevent such bowing due to unequal pressures in the two compartments, a small slot 106 is formed in an edge of the film laminate. This slot permits fluid communication between the two compartments (105, 108) to equalize the pressures therein. An aperture in the film laminate could also be used.

As particularly shown in the detail view illustrated in Figure 7, slot 106 is coincident with

vent 80. Thereby, each of compartments 105, 108 formed within members 60, 62 is vented through vent 80. As described above, any condensation that may be formed within either or both of the compartments will drain through vent 80; as is noted above, the side of plastic block 10 containing vent 80 should always be mounted to face downwardly.

As representatively illustrated in Figure 8, solar radiation, depicted by arrows 110, 111, impinges upon surface 112 of member 60. A certain amount of the solar radiation is reflected from surface 112, as depicted by arrow 113. A further quantity of solar radiation impinging upon film laminate 100 is reflected, as depicted by arrow 114. The quantity of solar radiation reflected from the film laminate is a function of the reflective characteristics of the film laminate and may be varied by selecting components for the film laminate from materials having certain desired solar radiation reflective/absorbtive properties; generally, this is a function of the parameters of the spectrally selective coating incorporated in the film laminate. When the solar radiation impinges upon interior surface 115 of member 62, a further quantity of solar radiation will be reflected, as depicted by arrow 116. The remaining solar radiation, depicted by arrow 117, will enter the environment on the other side of plastic block 10. One may therefore come to the inescapable conclusion that the amount of solar radiation reflected by a plastic block 10 having film laminate 100 mounted therewithin is a function of the choice of materials for the film laminate. As material can be selected with different transmissive and reflective characteristics to different frequencies of solar radiation, control of tranmissivity and reflectivity through plastic block 10 is readily achieved by selecting film laminate 100 (or a coating incorporated therewith) of a material corresponding with the desired results. It is also to be noted that the sides of

members 60, 62 through which solar radiation is transmitted have a property for absorbing a certain amount of radiation. Similarly, the material of film laminate 100 has a property for absorption of solar radiation.

Referring to Figure 9, there are illustrated two plastic blocks 10 mounted one above the other. The mounting and interconnections therebetween are described in detail above. To ensure sealing of the junction between adjacent blocks, a rubberized silicon grout 120, or the like, may be troweled in the peripheral cavity formed at the junction of the blocks.

As discussed above, film laminate 100 may be retained in place simply by mating members 60, 62 with one another. In the event manufacturing tolerances of the plastic blocks may cause either unacceptable compression/bowing of the film laminate or a too loose a fit, a mastic or adhesive 124, such as acrylic glue, may be used, as depicted in Figure 9A. An adhesive suitable for this purpose is identified as WELD-ON 3 sold by IPS Corporation of Compton, California. Use of such adhesive would permit wider tolerances for the manufacture of the edges of members 60, 62 and yet not compromise the fit and retention of film laminate 100. Furthermore, adhesive 126 used to join the blocks with one another may be used to also secure film laminate 100 therebetween. Other methods of attachment, such as melting by application of heat, welding by any of various processes or chemical welding may be employed.

Figure 10 illustrates a commercially available frame 130 used to define an opening to be filled with a plurality of plastic blocks 10. This frame includes a shoulder 132 bearing against

plastic block 10 and permits installation of a plurality of plastic blocks within the perimeter of the frame. A clip or glazing stop 134 interconnects with frame 130 and bears against the other side of plastic block 10 to serve in the manner of a stop or dam to prevent displacement of the plastic block from within the frame. To obtain a seal between plastic blocks 10 and frame 130, grout 120 may be used.

Figure 11 shows an alternative commercially available frame 140 of aluminum to define the perimeter of a space within which plastic blocks 10 are to be mounted. To prevent heat transmission through frame 140, exterior and interior elements 142, 144 are mechanically joined and thermally insulated from one another by an element 146 having the requisite properties. Flanges 148, 150 extend inwardly from frame 140 for mating engagement with the corresponding edges of plastic block 10. Grout 120 may be used to seal the junction between each of the plastic blocks and the frame.

As shown in Figure 12, a frame 160 is formed in the requisite size to accommodate the location of the installation. A plurality of plastic blocks 10 are mounted therein. It is to be noted that the frame may be constructed off site with plastic blocks 10 mounted therein. Thereafter, the unit, as a whole, may be delivered to the site of the installation. Such off site construction has several advantages. These include installation of the plastic blocks within the frame by skilled artisans to ensure accurate fitting and sealing. The location of assembly may be in an environment conducive to comfort of the assemblers to minimize frustration and anger and presumably resulting in a high quality of workmanship. By constructing the assemblies in an off

site environment, mass production techniques can be employed to minimize labor costs. Others skilled in the trade will become aware of yet further advantages.

Film laminate 100, shown as part of the exploded view in Figure 6, preferably is made of three components, as shown in Figure 13. A clear polyester (PET) film 170, which may be approximately 6.5mil thick, is coated with a corrosion resistant nickel alloy vacuum sputter coating layer 172, which may be approximately 0.25mil thick. To protect the coating layer, a clear protective polyester (PET) film 174 is laminated to film 170. To serve its protective function, film 174 need only be about 0.25mil thick. The coating layer is a spectrally selective coating that increases the total energy performance of film laminate 100. In particular, it rejects approximately 63% of the solar heat energy and absorbs approximately 52% of the solar heat energy. It has the further capability of lowering the emissivity of the laminate film (0.84 emissivity) and reflects approximately 26% of the solar heat energy. The film laminate also offers the benefits of rejecting approximately 99% of ultra violet light and reduces approximately 73% of sunlight glare.

Film laminate 100 is particularly adapted for use with the plastic blocks described herein if it is of the type mentioned above and identified by product number N1020 SR CDF. These benefits include the fact that it is sufficiently thin to be placed between the two members of plastic block 10 without increasing the overall thickness to any appreciable or practical degree. It is stiff enough to rest in place during assembly of the plastic block without further modifications to the members of the plastic block to retain it during assembly. Film laminate 100 is sufficiently

stable to permit cutting to tight tolerances, including the formation of slot 106. The coating layer selected for the film laminate has the benefit of reducing solar heat gain and the resulting total U-factor is low. Furthermore, it resists weathering that might otherwise occur in the normal environments for the plastic blocks and it is chemically and structurally compatible with the materials of the plastic blocks, whether made of acrylic or other materials. Furthermore, it resists any possible corrosion during use and despite the possible inflows and outflows of air through vent 80 in the plastic blocks.

While the film laminate described above and illustrated in Figure 13 is preferable, other commercially available films are functionally compatible with the plastic blocks. These include: heat mirror film intended for application within dual pane insulated glass; radiant light film obtainable from the 3 M Company and having specific optical selectability; dark tinted window films similar to products used on automotive glass; clear or tinted glass or acrylic sheet products; film laminates with less stable and/or more corrosive coatings (i.e. silver alloy vacuum sputter coating); vinyl film coverings with minimal visible or light transmittance; and, electric chromatic devices with radiant light adjustability.

Acrylic blocks having film laminate 100, as illustrated and in described with respect to Figure 13, have undergone substantial testing to evaluate the total performance. The results of these tests are set forth in Figure 14. These results show an increase in thermal performance (U-factor) over glass blocks of approximately 34% and an increase in solar heat gain performance (S.H.G.C.) of approximately 35%. In comparison to plastic blocks without film laminate 100,

there has been an increase in thermal performance (U-factor) of approximately 30% and an increase in solar heat gain performance (S.H.G.C.) of approximately 41%.

As set forth in Figure 15, the U.S. Department of Energy's ENERGY STAR program has adopted regional requirements for window and door manufacturers who wish to participate in this program. To the knowledge of the present inventors, the plastic block embodying film laminate 100 is the only unit to be involved in the ENERGY STAR program and qualifies for the program across all of the United States climatic regions.

In summary, the plastic blocks described and claimed herein have undergone durability and accelerated weathering testing and have proven to withstand all environmental conditions and product usage that may be encountered in most situations. The energy performance increases offered over glass block products and other previously existing window blocks is largely significant over all areas of testing. That is, the present invention far surpasses any other similar or competitive products that have been introduced to date and will continue to offer advantages in the future.